

INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET
ELECTRON TUBE, NEGATIVE GRID (MICROWAVE)
TYPE 7289

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the electron tube described herein shall consist of this document and the latest issue of MIL-PRF-1.

DESCRIPTION: Triode, planar, ceramic and metal.
See figure 1.
Mounting position: Any.
Weight: 2.5 ounces (.71 grams) nominal.

ABSOLUTE RATINGS:

Parameter:	F1	Ef	Eb	eb	epy	Ec	Ik	Ib	ib	Ic	ic
Unit:	GHz	V <u>2</u> /	V dc	v	kv	V dc	mA dc	mA dc	a	mA dc	a
Maximum:											
CW osc	2.5	6.0 ±5%	1,000	---	---	-150	125	---	---	50	---
Anode mod CW osc or amp	2.5	6.0 ±5%	---	1,200 <u>3</u> /	---	-150	100	---	---	50	---
Anode pulsed osc or amp <u>1</u> /	3.0	6.0 ±5%	---	---	3.5	---	---	---	3	---	1.8
Test conditions:	---	6.0	1,000	---	---	Adj	---	100	---	---	---

ABSOLUTE RATINGS:

Parameter:	tp	Du	Pp	Pg	tk	TE	T (anode shank) °C (Figure 1, note 5)	Cooling	Barometric pressure, reduced mmHg
Unit:	μs	---	W <u>4</u> /	W <u>6</u> /	sec (min)	°C <u>7</u> /	---	---	---
Maximum:									
CW osc	---	---	100	2	60	300	300	---	54
Anode mod CW osc or amp	---	---	100 <u>5</u> /	2	60	300	300	---	54
Anode pulsed osc or amp <u>1</u> /	3	0.0025	27	---	60	300	300	---	---
Test conditions:	---	---	---	---	300	---	---	<u>8</u> /	---

See footnotes at end of table I.

GENERAL:

Qualification: Required.

TABLE I. Testing and inspection.

Inspection	MIL-STD-1311 Method	Notes	Conditions	Acceptance level 30/	Symbol	Limits		Unit		
						Min	Max			
<u>Conformance inspection, part 1</u>										
Insulation of electrodes	1211	---	Eb = Ek = 0; Ec = -500 V dc	0.65	R	50	---	MegΩ		
Power oscillation	1236	13/ 16/	F = 2.5 GHz (min); Ebb = 1,000 V dc; Ib = 90 mA dc; Ef = 5.0 V	0.65	Po	15	---	W		
Electrode voltage (1) (grid)	1261	17/		0.65	Ec	-2.0	-7.0	V dc		
Total grid current	1266	17/		0.65	Ic	---	-8	μA dc		
Pulse emission (1)	2212	---	Eb = 145 V dc; Ec = -10 to -150 V dc; egk/ik = 750 ma; Ef = 5.4 V; prf = 11 ± 1 pps; tp = 4,500 μs (min); tr = tf = 25 μs; slope = 0.5 percent; ripple = 0.1 percent	0.65	Δik	---	120	ma		
Current division (long pulse)	1372	---	Pulse emission (1), except egk/ib = 460 ma; Ef = 6.0 V	0.65	egk ic	14 200	22 320	v ma		
Heater current	1301	---		0.65	If	0.90	1.05	A		
<u>Conformance inspection, part 2</u>										
Power oscillation (pulse)	1236	13/ 19/	F = 3.0 GHz (min); epy = 3.5 kv; Ec = -1.5 V (min); Rg/Ib = 7.5 mA (max); Ic = 4.5 mA (max); Ef = 5.8 V	---	Po	4	---	W		
Direct-interelectrode capacitance	1331	13/ 20/	No voltages	} } }	{ { {	Cin Cgp Cout	5.6 1.95 ---	7.0 2.15 0.035	pF pF pF	
Resonance	---	13/ 21/	No voltages			---	---	---	---	---
Grid distortion	---	13/ 22/				---	ΔF	+1	-7	MHz
Electrode voltage (2) (grid)	1261	---	Ec/Ib = 1.0 mA dc	---	Ec	---	-25	V dc		

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	MIL-STD-1311 Method	Notes	Conditions	Acceptance Level 30/	Symbol	Limits		Unit
						Min	Max	
<u>Conformance inspection, part 2</u> - Continued								
Grid arc	---	---	See figure 2	---	---	---	---	---
Pulse emission (2)	2212	---	Pulse emission (1) except Ef = 6.0 V	---	Δik	---	60	ma
<u>Conformance inspection, part 3</u>								
Life test (1)	---	11/	Group S (monthly); F = 2.0 GHz (min); Ebb = 1,000 V dc; Ef = 5.0 V; t = 200 hours	---	---	---	---	---
Life-test (1) end-points:	---							
Power oscillation	1236	---		---	ΔPo t	---	-25	%
Pulse emission (2)	2212	---		---	Δik	---	120	mA
Life test (2)	---	10/	Group C; Ef = 6.0 V; F = 5 kHz ± 10%; Ebb = 1,000 V dc; eg and Rk/Ik = 125 mA dc (min); Ic = 45 mA dc (min); TA = 250°C (min); t = 100 hours	---	---	---	---	---
Life-test (2) end-point:	---							
Pulse emission (2)	2212	---		---	Δik	---	120	ma
Life-test (3)	---	9/	Group S (weekly); Ef = 6.0 V; t = 500 hours; filament standby	---	---	---	---	---
Life-test (3) end-points:	---							
Power oscillation	1236	---		---	ΔPo t	---	-25	%
Pulse emission (2)	2212	---		---	Δik	---	120	ma

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	MIL-STD-1311 Method	Notes	Conditions	Acceptance Level <u>30</u> /	Symbol	Limits		Unit
						Min	Max	
<u>Conformance inspection, part 3</u> - Continued								
<u>Periodic check tests</u>								
Barometric pressure, reduced	1002	<u>23</u> /	Pressure = 54 mmHg (max); voltage = 1,000 V ac; TA = 30°C ± 10°C	---	---	---	---	---
Variable-frequency vibration	---	<u>13/ 18/ 24</u> /	F = 55 to 500 Hz; 10 G peak (min); Ec/lb = 10 mA dc; Rp = 10,000 ohms; Ebb = 300 V dc	---	Ep	---	250	mV ac
Vibration fatigue	1031	<u>13/ 14/ 26</u> /	Eb = Ec = 0; Ef = 6.0 V	---	---	---	---	---
Fatigue-test end-point:	---							
Total grid current	1266	<u>27</u> /		---	Ic	---	-10	μA dc
Torque	---	<u>13/ 25/ 28</u> /	No voltages	---	---	---	---	---
Torque-test end point:	---							
Total grid current	1266	---		---	Ic	---	-10	μA dc
Shock (1)	1041	<u>12/ 13/ 14/ 18</u> /	400 G peak (min); duration = 0.5 ms (min); no voltages; use jig in accordance with Drawing 159-JAN	---	---	---	---	---
Shock-test (1) end point:	---							
Total grid current	1266	<u>27</u> /		---	Ic	---	-10	μA dc
Shock (2)	1041	<u>12/ 13/ 14/ 18</u> /	60 G peak (min); duration = 11 ± 2 ms; no voltages; use jig in accordance with Drawing 280-JAN	---	---	---	---	---
Shock-test (2) end-point:	---							
Total grid current	1266	<u>27</u> /		---	Ic	---	-10	μA dc

See footnotes at top of next page.

TABLE I. Testing and inspection - Continued.

- 1/ For grid-pulse operation, the maximum CW ratings shall apply.
- 2/ The transit-time heating effect of the cathode shall be compensated for by a reduction in heater voltage after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of ± 5 percent from optimum is permitted. No reduction in heater voltage is required up to and including 500 MHz.
- 3/ 1,200 volts is at the crest of the audio wave.
- 4/ Up to 100 watts dissipation is allowable with forced-air cooling of the anode.
- 5/ For 100 percent modulation including dissipation resulting from power supplied by the modulator.
- 6/ The maximum instantaneous peak grid voltage for CW ratings shall be within the range of +30 to -400 volts.
- 7/ Maximum envelope temperature shall be limited to the specified maximum of 300°C under all operating conditions. Where emphasis is placed on long life and reliability, lower tube envelope temperatures shall be used.
- 8/ Sufficient conduction or convection cooling shall be provided for all seals to limit temperatures in accordance with 7/. For anode cooling, an airflow of 12.5 cfm minimum shall be supplied at sea level, and with airflow at 25°C maximum directed with a cowl as shown on Drawing 157-JAN. Where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial. Unless otherwise specified, conduction cooling or an airflow of up to 12.5 cfm may be supplied for anode cooling in all electrical tests involving application of heater voltage.
- 9/ Group S shall apply, except that it shall be permissible to represent a lot not to exceed one month's production with a sample consisting of four times the stated (weekly) sample, both for the multiple short life test and the sequential life test.
- 10/ Test in circuit in accordance with figure 3, or equivalent.
- 11/ Life test shall be run in a self-excited oscillator cavity.
- 12/ Each tube shall be subjected to a total of 15 shocks; that is, 5 shocks in each axis X, Z+ and Z- in any sequence as shown on figure 1.
- 13/ Other tube contact configurations may be used provided the tube contact area remains unchanged and the socket, jig, or cavity gives equal performance. Mounting of the jig, socket, or cavity may be at the option of the manufacturer.
- 14/ Tubes subjected to destructive tests shall not be delivered on the contract or order.
- 15/ All tests listed under conformance inspection, part 1, are to be performed at the conclusion of the holding period.
- 16/ Test to be made in cavity in accordance with Drawing 160-JAN. The cavity shall be connected to a standard load with a VSWR less than 1.5:1. The output coupling from the oscillator and grid or cathode resistor, or both, may be adjusted for maximum power output.
- 17/ Airflow through the anode radiator shall be between 3.5 and 4.0 cfm with cowl as shown on Drawing 157-JAN. The grid current shall be measured at not less than 5 minutes after anode dissipation has been set at 100 watts.
- 18/ Perform test on 10 tubes selected at random from the first production lot of each calendar year. If more than one tube fails, the test shall become a part of conformance inspection, part 2, with acceptance level 6.5 and inspection level S3, on all lots in process. After three consecutive successful submissions, the test shall revert to a 10-tube annual test.
- 19/ The applied voltage pulse shape shall be measured with noninductive resistor of 1,150 ohms ± 2 percent inserted in place of the tube. The pulse shape shall be $t_p = 3.0 \mu s \pm 10$ percent, $t_r = 0.4 \mu s$ maximum, $t_f = 0.7 \mu s$ maximum. The pulse repetition rate shall be adjusted so that $D_u = 0.0025 \pm 5$ percent with the above measured pulse length. Test in cavity in accordance with Drawing 279-JAN. The cavity shall be connected to a load with a VSWR less than 1.5:1. The oscillator output coupling and grid or cathode resistor may be adjusted for maximum power output.

TABLE I. Testing and inspection - Continued.

20/ Measured in socket in accordance with Drawing 158-JAN.

21/ Grid-anode resonance: Test in cavity in accordance with Drawing 278-JAN. Cavity shall resonate at $1.354 \text{ GHz} \pm 2.0 \text{ MHz}$ with tuning slug in accordance with Drawing 277-JAN at $TA = 25^\circ\text{C} \pm 5^\circ\text{C}$.

Grid-cathode resonance: Test in cavity in accordance with Drawing 283-JAN. Cavity shall resonate at $1.719 \text{ GHz} \pm 2.0 \text{ MHz}$ with tuning slug in accordance with Drawing 277-JAN at $TA = 25^\circ\text{C} \pm 5^\circ\text{C}$.

When plotted on graphs of resonant frequency versus grid-anode capacitance and resonant frequency versus grid-cathode capacitance, the tube under test shall be represented by a point within a parallelogram whose four corners are located by the following points:

Points	Capacitance (pF)		Frequency (GHz)	
	<u>C-gp</u>	<u>C-gk</u>	<u>F-gp</u>	<u>F-gk</u>
1	1.95	5.6	1.955	1.784
2	1.95	5.6	1.985	1.814
3	2.15	7.0	1.900	1.751
4	2.15	7.0	1.930	1.781

22/ Test shall be made in cavity in accordance with Drawing 281-JAN. Calibrate the circuit by adjusting the cavity until the frequency of resonance is $2.0 \text{ GHz} \pm 5 \text{ MHz}$ at room temperature, with a tube which meets the resonance test requirements. In the grid-distortion test, the frequency shall first be measured with $E_f = 6.0$ volts, then the grid dissipation increased to 2 watts with $E_b = -150 \text{ V dc}$. The change in frequency shall be not greater than the limit specified herein. Cooling air at room temperature may be used.

23/ Voltage shall be 60 Hz ac applied between anode and grid. No other voltages shall be applied. There shall be no evidence of failure as indicated by an arc-over. Perform test on 10 tubes selected from the first production lot of each year. If more than one tube fails, the test shall become a part of conformance inspection, part 2, with acceptance level 6.5 (see 30/). After three consecutive successful submissions, the test shall revert to a 10-tube annual test. This is not a destructive test.

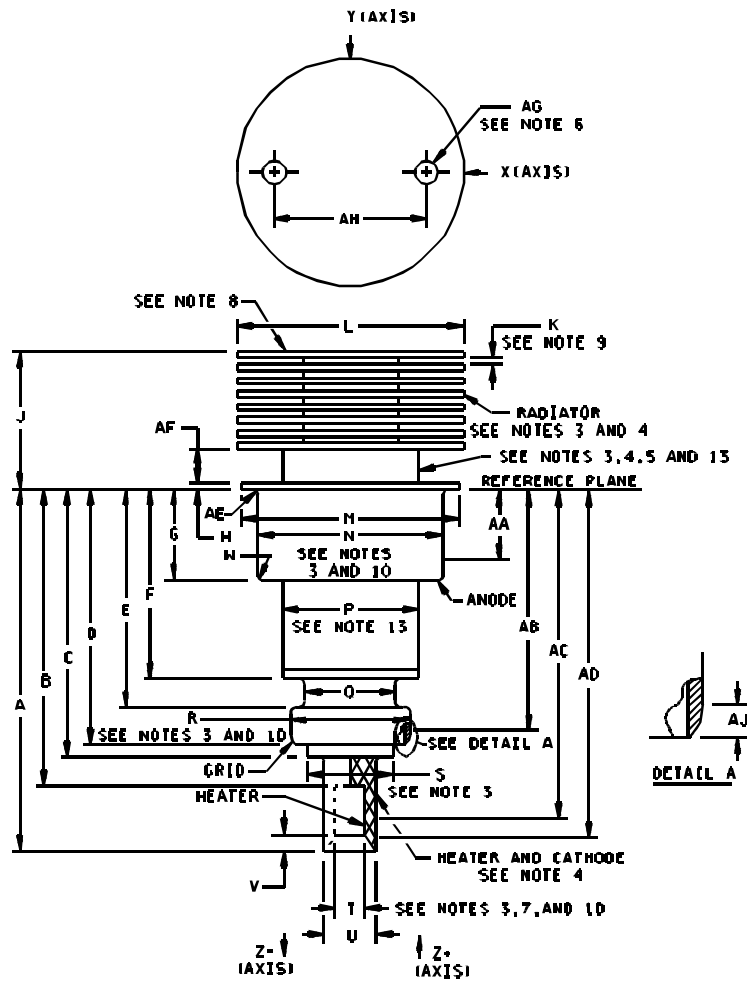
24/ The tube shall be mounted in socket in accordance with Drawing 276-JAN and vibrated with simple harmonic motion. The peak acceleration over the frequency range shall be within ± 20 percent of the reference acceleration at 100 Hz. The frequency shall vary from 55 to 500 Hz and return to 55 Hz with approximately logarithmic progression and shall require 4 minutes minimum, 6 minutes maximum to traverse the range. Each tube shall be vibrated for 30 minutes in each axis X and Z, except that if the cumulative result of tests on 50 or more tubes of a construction show that more than 75 percent of the tubes have higher output voltages in one axis, subsequent measurements need to be taken only in the axis giving the higher reading. The voltages specified herein shall be applied to the tube during vibration. The value of the alternating voltage, E_p , produced across the resistor, R_p , as a result of vibration shall be measured with a suitable device. This device shall have an appropriate voltage range, shall have the ability to measure, with an error of less than 10 percent, the rms value of a sine wave of voltage at all frequencies from 20 to 20,000 Hz. The value of the vibrational output, E_p , shall not exceed the limit specified herein at any point in the sweep-frequency range during the last complete cycle of cycling vibration.

25/ Test 10 tubes selected at random from the first production lot of each calendar year and approximately every 90 days during the year. If more than one tube fails to pass the specified end points, the failed test shall become a part of conformance inspection, part 2, with acceptance level 6.5 (see 30/), on all lots in process. After three consecutive successful submissions, the test shall revert to a 10-tube quarterly test. This is a nondestructive test, except in case of failure.

26/ Test four tubes selected at random from the first production lot of each year. If one or more tubes fail to pass the specified end points, the failed test shall become a part of conformance inspection, part 2, with acceptance level 6.5 (see 30/), on all lots in process. After three consecutive successful submissions, the test shall revert to a 4-tube annual test. This is a destructive test.

TABLE I. Testing and inspection - Continued.

- 27/ The following does not apply: Tubes which show permanent or tap shorts or open circuits following the applicable test.
- 28/ Torque test shall be performed as follows:
- a. The tube shall be held securely at the cathode connection. A force of 5 pounds shall be applied to the heater cup without perceptible shock. This test may be made by applying the force at right angles to the inside of the cup at a point .109 inch (2.78 mm) \pm .016 inch (0.40 mm) from the cathode end of the tube. An approved equivalent method may be used. The heater cup shall not loosen or short circuit on the cathode connection.
 - b. A torque of 15 inch-pounds shall be applied between anode and cathode without shock.
 - c. A torque of 40 inch-pounds shall be applied between anode and grid without shock.
- 29/ Revision letters are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.
- 30/ This specification sheet uses accept on zero defect sampling in accordance with MIL-PRF-1, table III.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 2				
A	1.815	1.875	46.10	47.62
B	---	1.534	---	38.96
C	---	1.475	---	37.46
D	1.289	1.329	32.74	33.76
F	.880	.920	22.35	23.37
G	.462	.477	11.73	12.12
J	.766	.826	19.46	20.98
N	1.025	1.035	26.04	26.29
R	.655	.665	16.64	16.89
T	.213	.223	5.41	5.66
U	.315	.325	8.00	8.26
Conformance inspection, part 3 (periodic check) (see note 2)				
E	1.085	1.135	27.56	28.83
H	---	.040	---	1.02
AF	.125	.185	3.18	4.70
K	.025	.046	0.64	1.17
L	1.234	1.264	31.34	32.11
M	1.180	1.195	29.97	30.35
P	.722	.792	19.61	20.12
Q	.541	.561	13.74	14.25
S	---	5.450	---	13.84
V	---	.086	---	2.18
W	---	.100	---	2.54
AE	---	.035	---	0.89
AG	.105	.145	2.67	3.68
AH	.650	.850	16.51	21.59
AJ	---	.040	---	1.02
Electrode contact areas (see note 12)				
AA	.035	.361	0.89	9.17
AB	1.185	1.265	30.10	32.13
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.46	46.10

FIGURE 1. Outline drawing of electron tube type 7289.

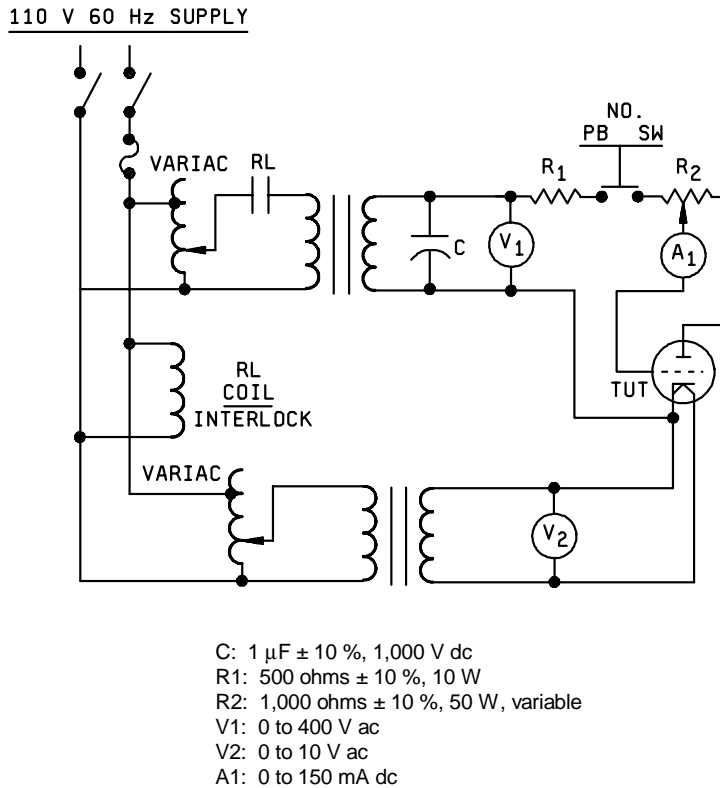
NOTES:

1. Insulation material is required between heater and heater-cathode and shall be securely affixed.
2. These dimensions shall be tested on 10 tubes per month when in continuous production. Failure of one or more tubes to meet tolerances for any dimension shall cause that dimension to become, for all lots in process, part of conformance inspection, part 2.
3. Silver plated 30 MSI minimum. Note 2 shall apply.
4. Plating not required over radiator and radiator support of copper, aluminum, or approved equivalent.
5. This surface shall be used for measurement of anode shank temperature.
6. Holes for tube extractor through top fin only.
7. Inner edge of heater and outer edge of cathode rf connection shall be free from burrs and sharp edges.
8. This fin shall withstand a 6-inch drop test without loosening and without distortion as judged by ability to maintain dimension K. Note 2 shall apply.
9. Distortion of fins permissible provided distance between adjacent fins at any point on circumference meets tolerances for dimension K.
10. Eccentricity of contact surfaces shall be gauged from center line of reference and shall be as follows. Note 2 shall apply.

<u>Contact surface</u>	<u>TIR, maximum</u>	<u>Reference</u>
Anode	.020 (0.51 mm)	Cathode
Grid	.020 (0.51 mm)	Cathode
Heater	.012 (0.30 mm)	Cathode

11. Diameters N, R, T, and U shall apply throughout entire contact areas as defined by dimensions AA, AB, AC, and AD, respectively.
12. Dimensions in electrode contact areas table are for socket design purposes and are not intended for inspection purposes.
13. This surface shall not be used for clamping or locating

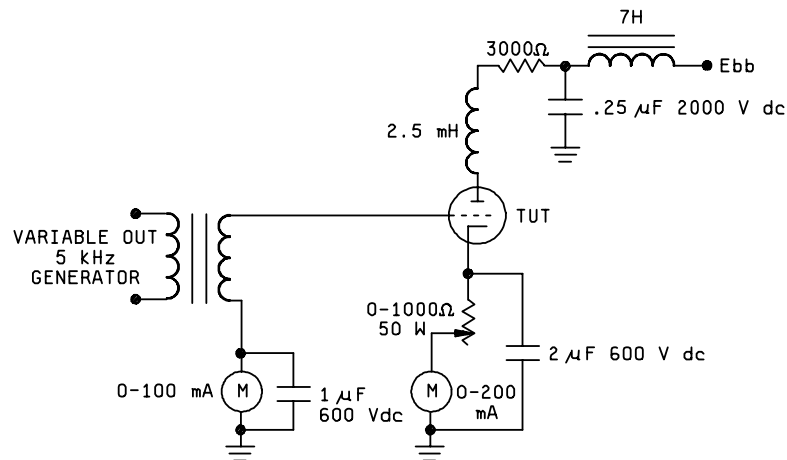
FIGURE 1. Outline drawing of electron tube type 7289 - Continued.



Test procedure:

1. Remove tube from preheat rack and place in test socket.
2. Check heater voltage at V2 (6.0 V ac) and grid voltage at V1 (285 V ac).
3. Press pushbutton switch, applying voltage between grid and cathode. Pushbutton switch is normally open.
4. Adjust R2 to 100 mA dc on A1 if necessary.
5. Hold pushbutton switch closed for at least 10 seconds. Tube shall be rejected if current drops to zero or fluctuates and continuous arcing occurs.

FIGURE 2. Grid arc test set wiring diagram.

FIGURE 3. 5 kHz life-test circuit. Component tolerances $\pm 10\%$ or better.

NOTES

Referenced documents. In addition to MIL-PRF-1, this specification sheet references MIL-STD-1311, Drawing 157-JAN, Drawing 158-JAN, Drawing 159-JAN, Drawing 160-JAN, Drawing 279-JAN, Drawing 278-JAN, Drawing 277-JAN, Drawing 276-JAN, Drawing 280-JAN, Drawing 283-JAN, Drawing 281-JAN.

Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the previous issue.

Custodians:

Army - CR
Navy - EC
Air Force - 99
DLA - CC

Preparing activity:

DLA - CC

(Project 5960-3719)

Review activities:

Army - AR, CR4
Navy - AS, CG, MC, OS, SH
Air Force - 11, 19

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.